CLAIMS:

1. A tubular reactor, for catalyzing reaction of hydrogen and a gaseous oxidant, the tubular reactor comprising:

an elongated housing,

a catalyst formed from a material adapted to promote catalytic combustion of the fuel and the oxidant, being formed into an elongated body substantially filling the elongated housing and being porous, a first inlet for a gaseous fuel and a second inlet for a gaseous oxidant, both first and second inlets being provided at one end of the elongated housing; and

an outlet at the other end of the housing, whereby, in use, the catalyst promotes combustion between the fuel and the oxidant to generate heat and moisture, whereby a heated and humidified gas flow exits through the outlet.

2. A tubular reactor as claimed in claim 1, wherein the housing and the body of the catalyst are both generally cylindrical and have a length substantially longer than the diameter thereof.

3. A tubular reactor as claimed in claim 1 or 2, which includes, for the first and second inlets, fittings for connection to supply lines for fuel and the oxidant, and for the outlet, a fitting for connection to a conduit for receiving the heated, humidified gas flow.

4. A fuel cell system comprising:

at least one fuel cell, each fuel cell comprising:

a main fuel inlet;

an anode having a catalyst associated therewith for producing cations from the fuel;

a fuel manifold, connected between the main fuel inlet and the anode, for distributing fuel to the anode;

an oxidant inlet means for supplying oxidant;

a cathode having a catalyst associated therewith and connected to the oxidant inlet means, for producing anions from the oxidant, said anions reacting with said cations to form water on said cathode;

an ion exchange membrane deposed between said anode and said cathode, said membrane facilitating migration of cations from said anode to said cathode, while isolating the fuel and the oxidant from one another; and

a catalytic reactor having a first inlet for fuel and a second inlet for an oxidant, and an outlet for heated and humidified fuel, the catalytic reactor being connected to the main fuel inlet, whereby, in use, with fuel and oxidant supplied to the catalytic reactor and the fuel being supplied in excess of the stoichiometric amount, heated and humidified fuel is supplied from the catalytic reactor to the main fuel inlet.

5. A fuel cell system as claimed in claim 4, which includes a plurality of fuel cells forming a fuel cell stack, which includes a main fuel inlet connected to all of the inlets of the fuel cells.

6. A fuel cell system as claimed in claim 4 or 5 wherein the catalytic reactor is generally tubular.

7. A fuel cell system as claimed in claim 5 wherein the outlet of the catalytic reactor is connected by a first control valve to the main fuel inlet of the fuel cell stack and by a second control valve to the oxidant inlet means whereby, in use, the outlet of the catalytic reactor can be selectively connected to one of the main fuel inlet and the oxidant inlet means, with supply of the oxidant as the fuel to the catalytic reactor adjusted so that the heated and humidified gas at the outlet of the catalytic reactor includes an excess of gas corresponding to said one of the main fuel inlet and the oxidant inlet means.

8. A fuel cell system as claimed in claim 7, which includes a fuel supply line connected to the catalytic reactor and an air supply line connected to the

catalytic reactor, each of the fuel supply line and the air supply line including, at least one of a pressure gauge, a flow meter and a non-return valve.

9. A fuel cell system as claimed in claim 5, wherein the oxidant inlet means comprises an air distribution manifold within the fuel cell stack for distributing air, as the oxidant, to individual fuel cells, wherein a main air supply line is provided connected to the air distribution manifold.

B3

10. A fuel cell system as claimed in claim 9, wherein the fuel cell stack includes a fuel outlet and means for recirculating fuel from the fuel outlet to the fuel inlet.

~~11.~~ A fuel cell system as claimed in claim 10, wherein the catalytic reactor is provided in the main air supply line, and wherein a second catalytic reactor is provided in the fuel supply line and a secondary air supply line connects the main air supply line to the secondary catalytic reactor, for a supply of air in an amount less than the stoichiometric amount required for combustion of fuel, whereby, the secondary catalytic reactor generates heated and humidified fuel.

12. A fuel cell system as claimed in claim 11, where each of the first and second catalytic reactors is generally tubular.

13. A method of operating a fuel cell system comprising a plurality of fuel cells, each fuel cell comprising an inlet for fuel, an anode having a catalyst associated therewith for producing cations from fuel, a fuel manifold connected between the inlet and the anode for distributing fuel to the anode, an oxidant inlet means for supplying oxidant, a cathode having a catalyst associated therewith and connected to the oxidant inlet means for producing anions from the oxidant, said anions reacting with said cations to form water on said cathode and an ion exchange membrane disposed between the anode and the cathode, for facilitating migration of cations from the anode to the cathode, while isolating the fuel and oxidant from one another, the method comprising

(a) supplying oxidant and fuel to the fuel cell for reaction to generate electrical power and heat;

(b) providing a catalytic reactor for promoting reaction of the fuel and the oxidant, supplying the fuel to the catalytic reactor and supplying the oxidant to the catalytic reactor in an amount less than the stoichiometric amount required for the combustion of the fuel to ensure complete consumption of the oxidant, thereby generating a flow of heated and humidified fuel; and

(c) supplying the heated and humidified fuel to the fuel cell, for reaction with the oxidant to generate electricity and heat.

14. A method as claimed in claim 13, which comprises, for initial start-up below a preset temperature, initially supplying fuel and oxidant only to the catalytic reactor to generate a flow of heated and moistened fuel, and passing the heated and moistened fuel through the fuel cell to preheat the fuel cell, and commencing supply of oxidant to the fuel cell, once the fuel cell reaches a desired temperature.

15. A method as claimed in claim 14, which includes, after start-up and after the cell has reached the desired temperature, supplying a sufficient quantity of the oxidant and the fuel to the catalytic reactor, to maintain the fuel supplied to the fuel cell system at a desired humidity level.

16. A method as claimed in claim 15, which includes: supplying air as the oxidant; providing the fuel cell system as an air-breathing system including vertical channels for flow of air as the oxidant; and providing only a portion of the air required as the oxidant through the catalytic reactor, with additional air flowing directly through the channels of the fuel cell system.

13